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Kennedy et al.

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(54) **HIGH TEMPERATURE CAPABLE JOINT ASSEMBLY FOR USE IN AIR-TO-AIR AFTERCOOLERS (ATAAC)**

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F28D 1/04 (2006.01)

(52) **U.S. Cl.**
CPC ***F02B 29/0456*** (2013.01); ***F28D 1/0417*** (2013.01)

(58) **Field of Classification Search**
CPC F02B 29/0456; F28D 1/0417; F28D 1/05366; F28D 2021/0082; F28F 1/025; F28F 9/10; F28F 9/001; F28F 9/12; F28F 9/08
USPC 60/599
See application file for complete search history.

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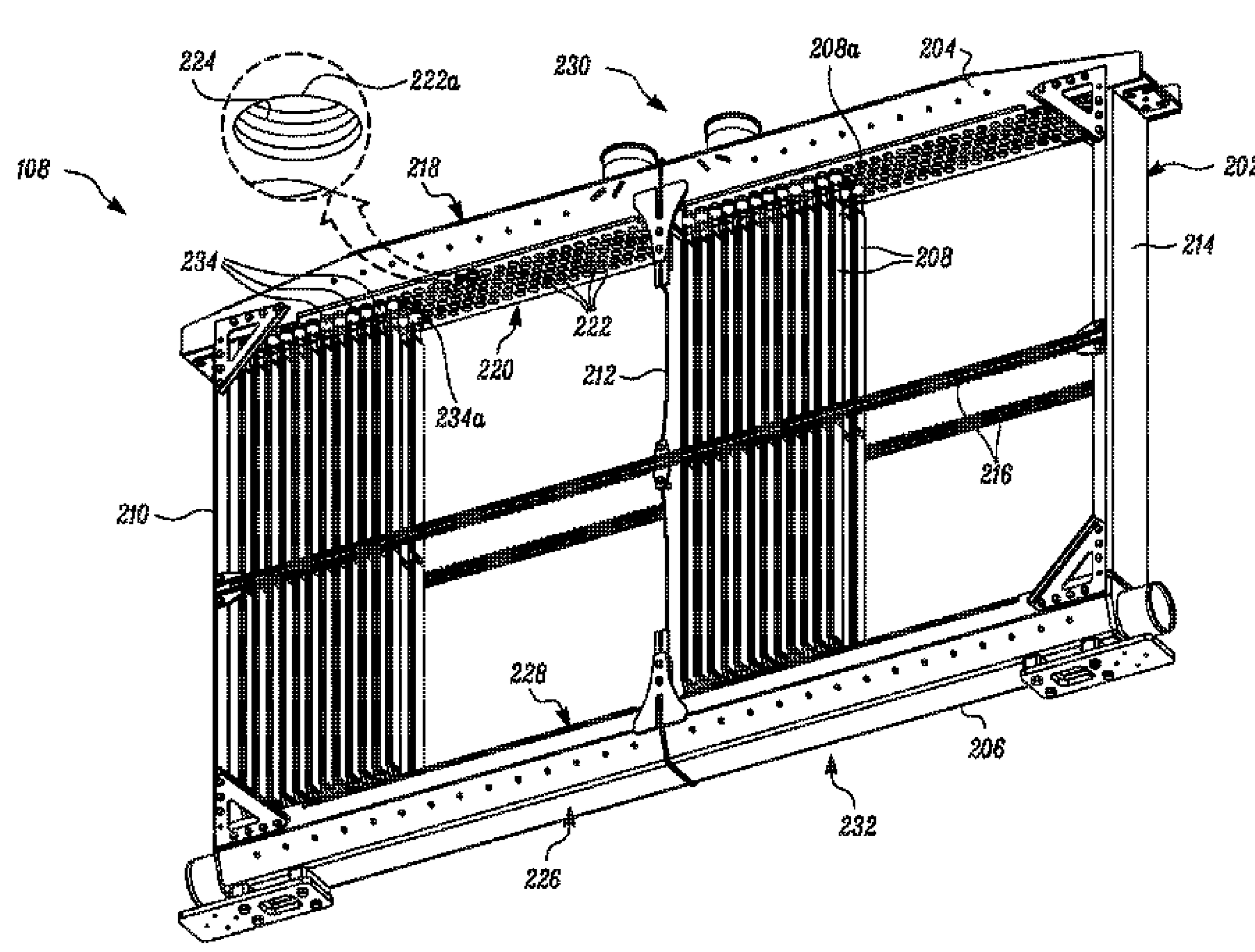
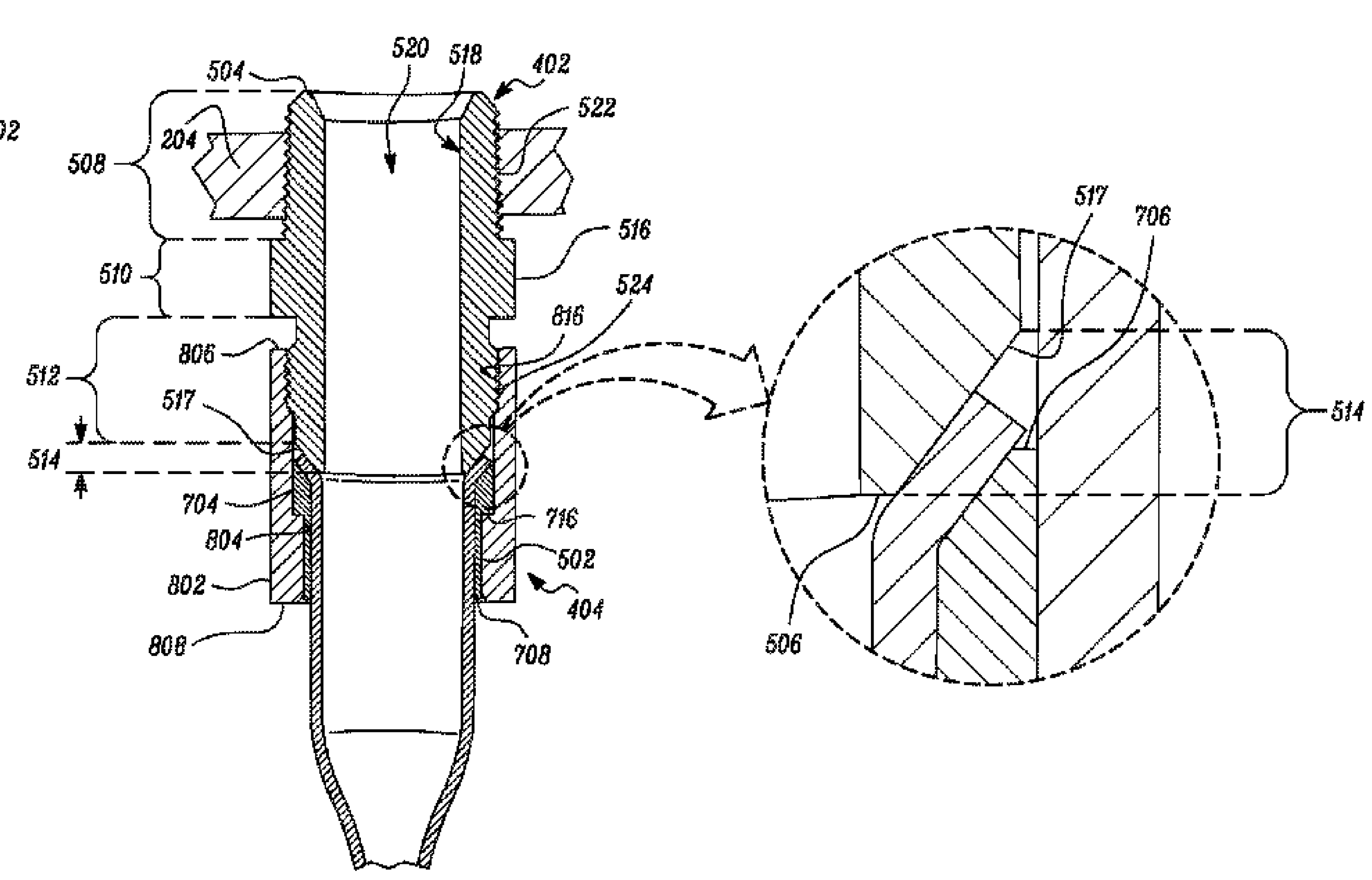
(57) **ABSTRACT**

The invention relates to an ATAAC having a header, a plurality of slots defined in the header, a plurality of core tubes coupled to the header, and a plurality of joint assemblies to couple the header with the plurality of core tubes. Each of the plurality of joint assemblies includes an adapter, a sleeve, and a nut. The adapter further includes a first section threadedly engaged with one of the plurality of slots. The adapter further includes a tapered section inserted inside a flared end portion of one of the plurality of core tubes. Furthermore, the adapter includes a second section defined between the tapered section and the first section. The sleeve disposed around the one of the plurality of core tubes, the sleeve is engaged with the flared end portion of the one of the plurality of core tubes. The nut is engaged with the sleeve and the second section of the adapter.

13 Claims, 9 Drawing Sheets





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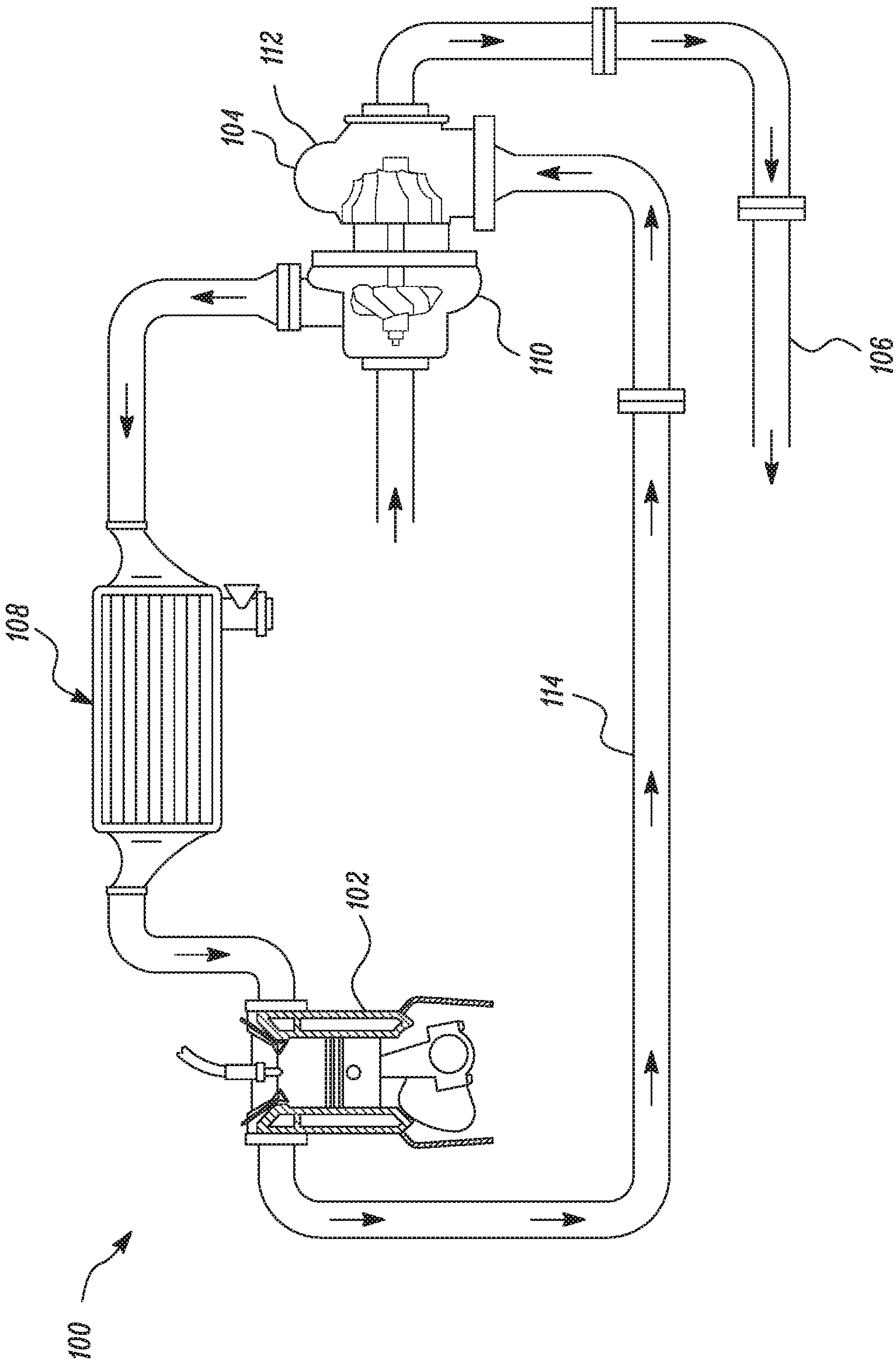


FIG. 1

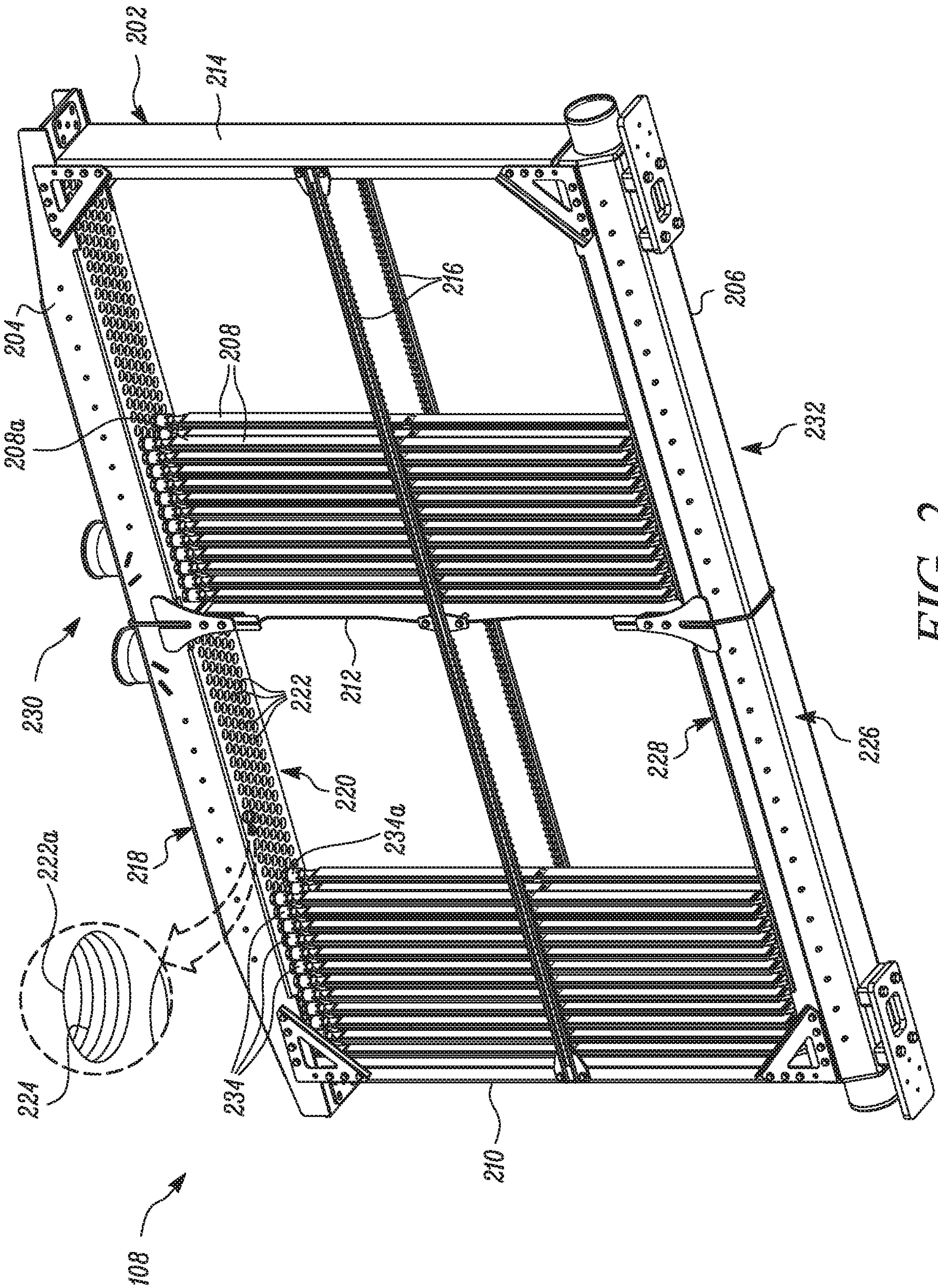

202
214
204
206
208
208a
216
232
212
222
230
220
218
222a
224
234
234a
210
226
228
108

FIG. 2

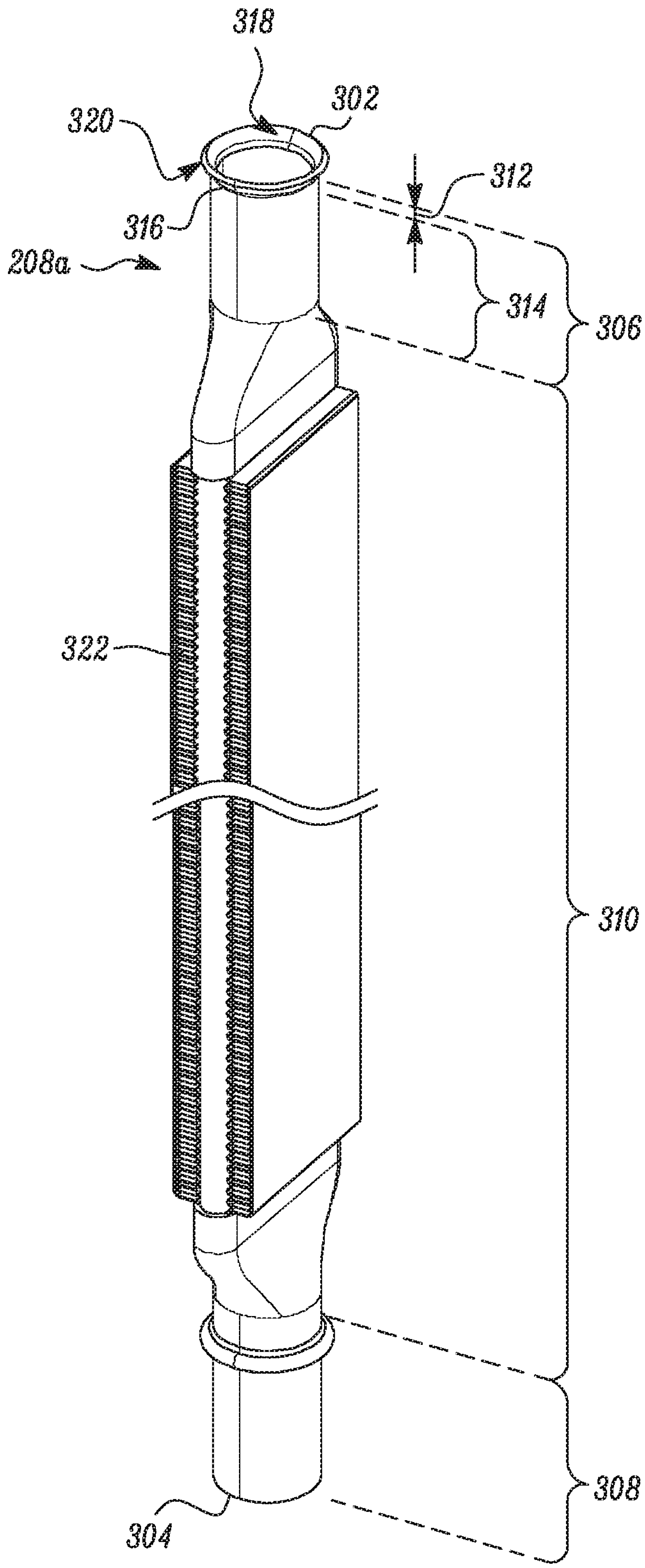


FIG. 3

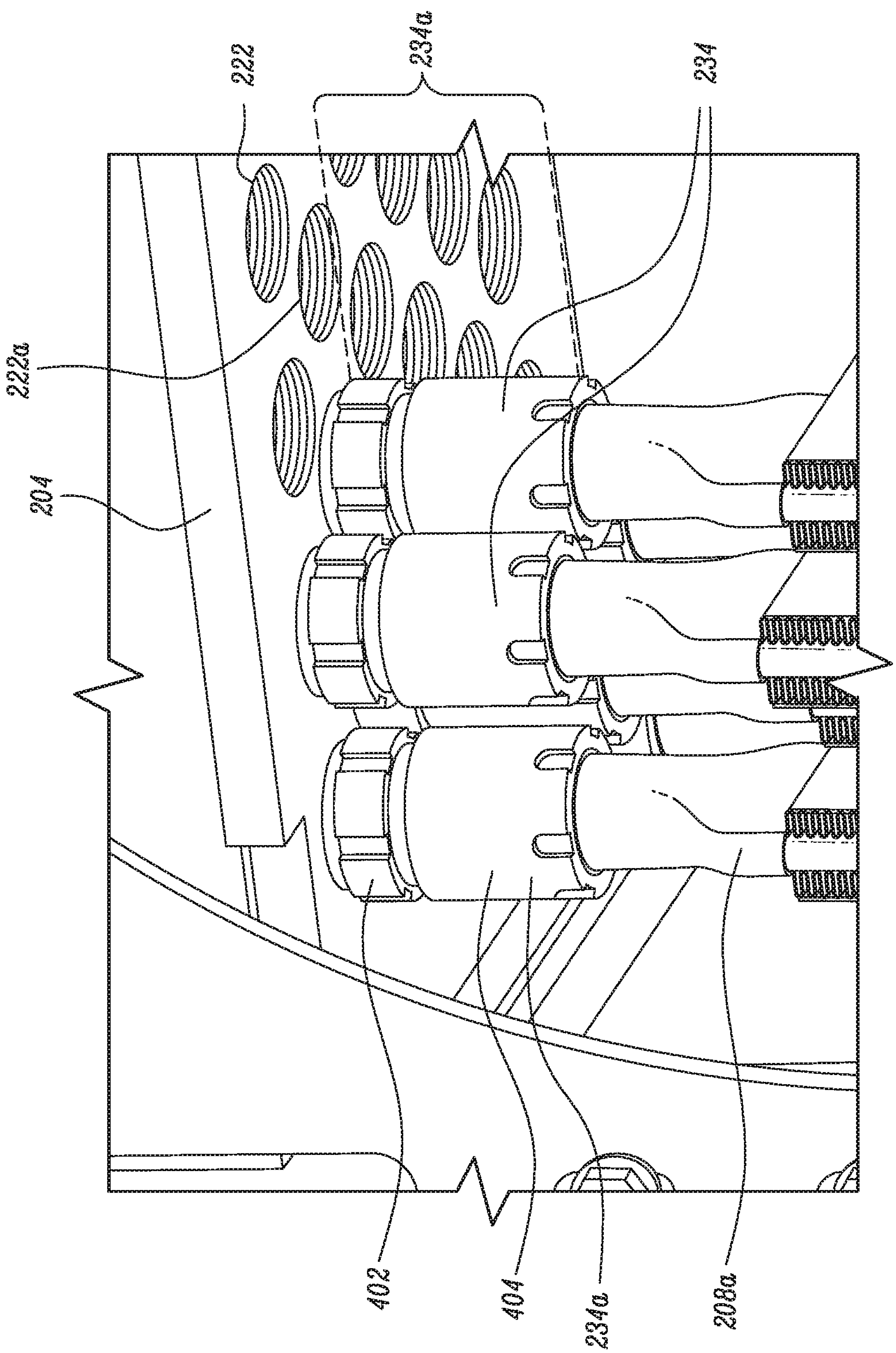
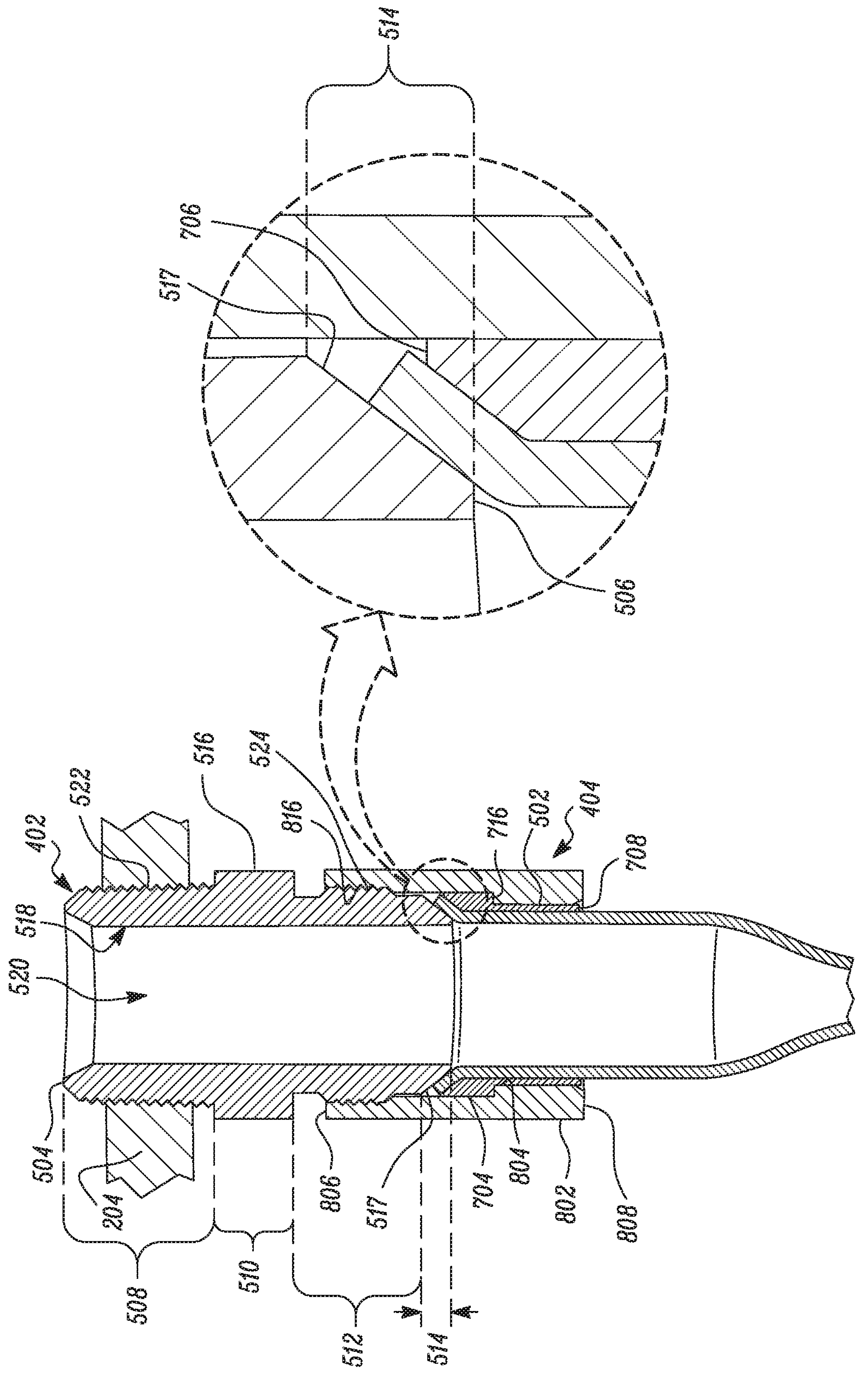


FIG. 4


514
706
517
506
402
522
516
524
816
716
502
404
708
520
518
504
204
806
517
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802
808
508
510
512
514

FIG. 5

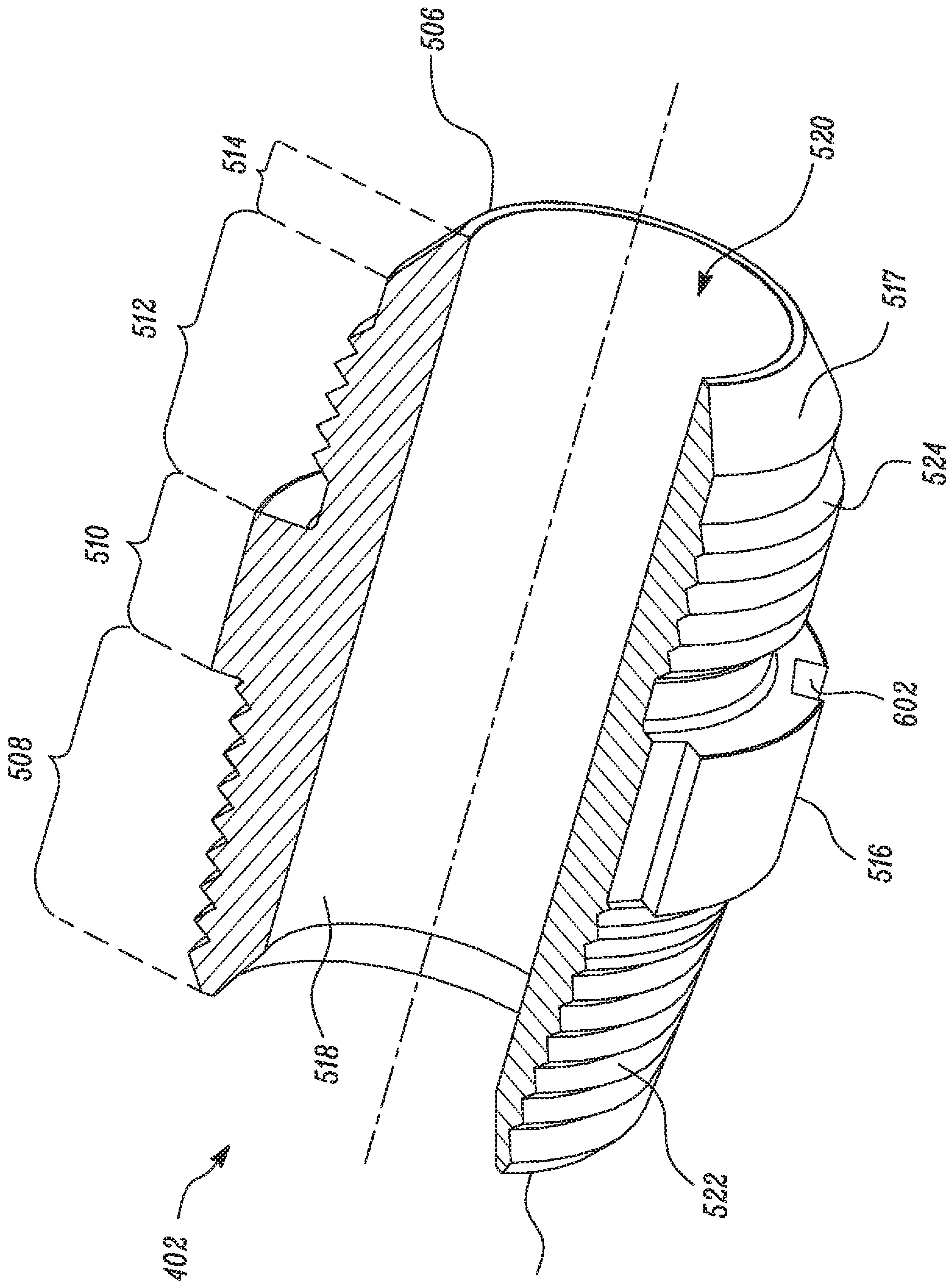


FIG. 6

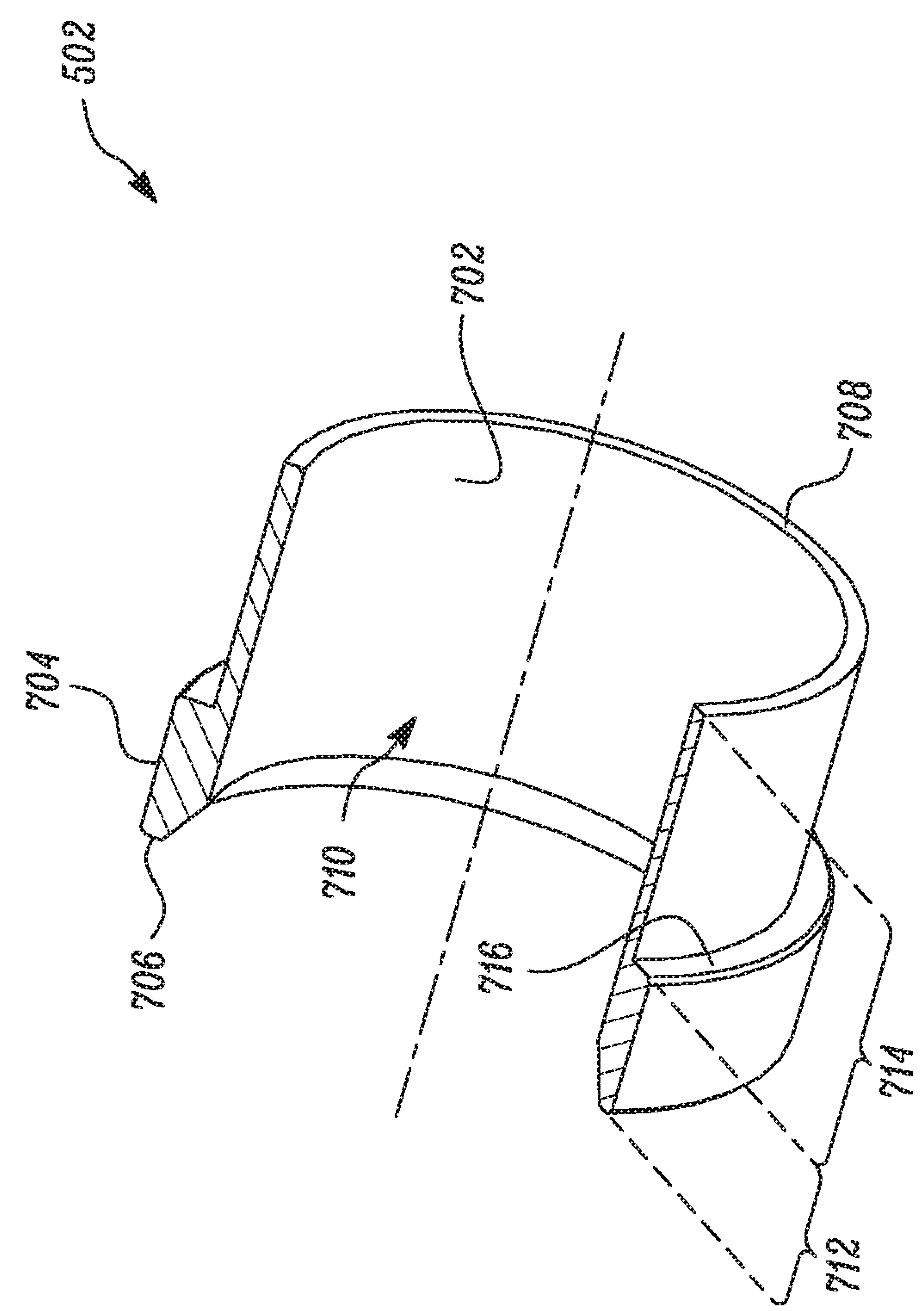


FIG. 7

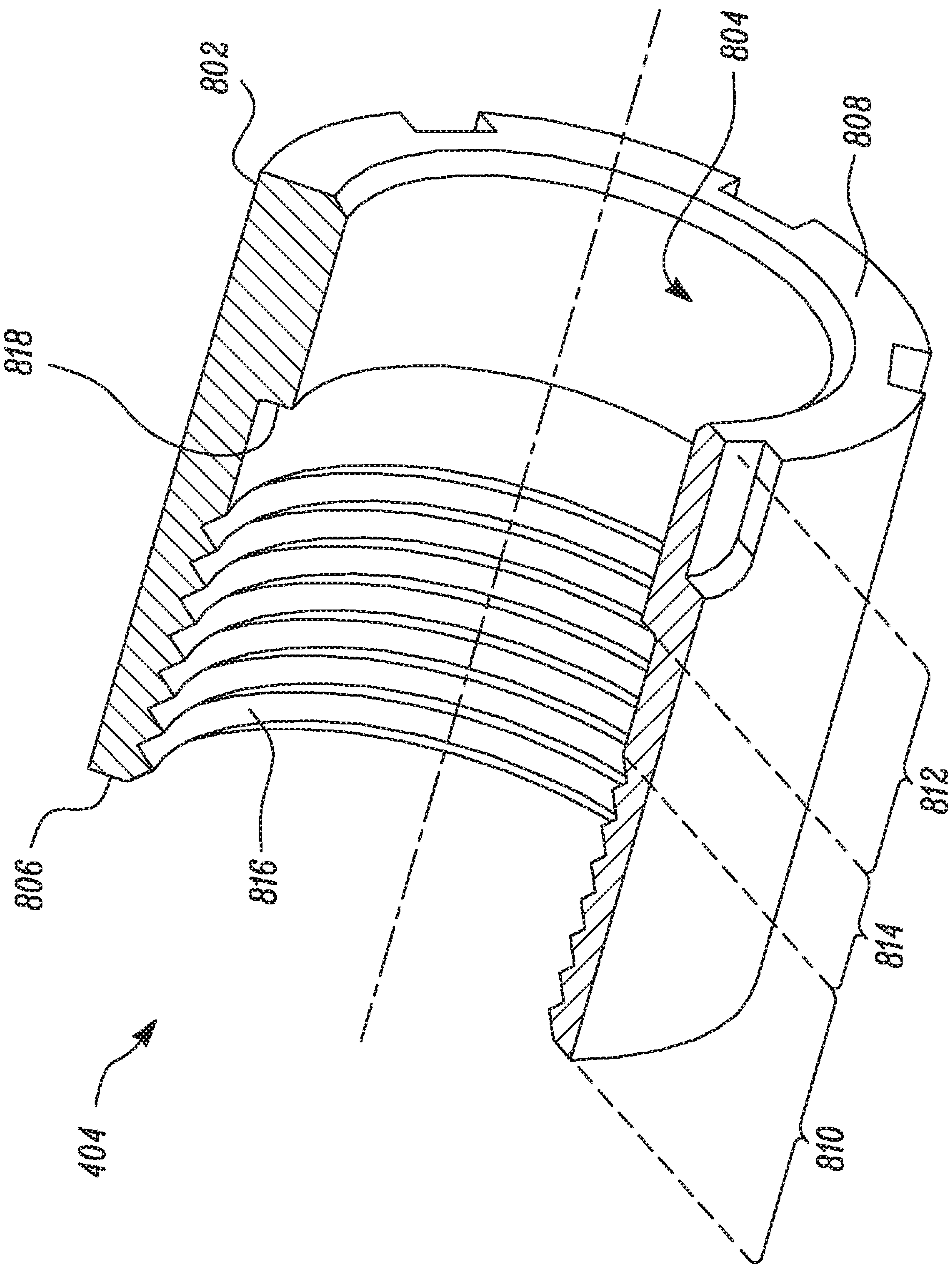
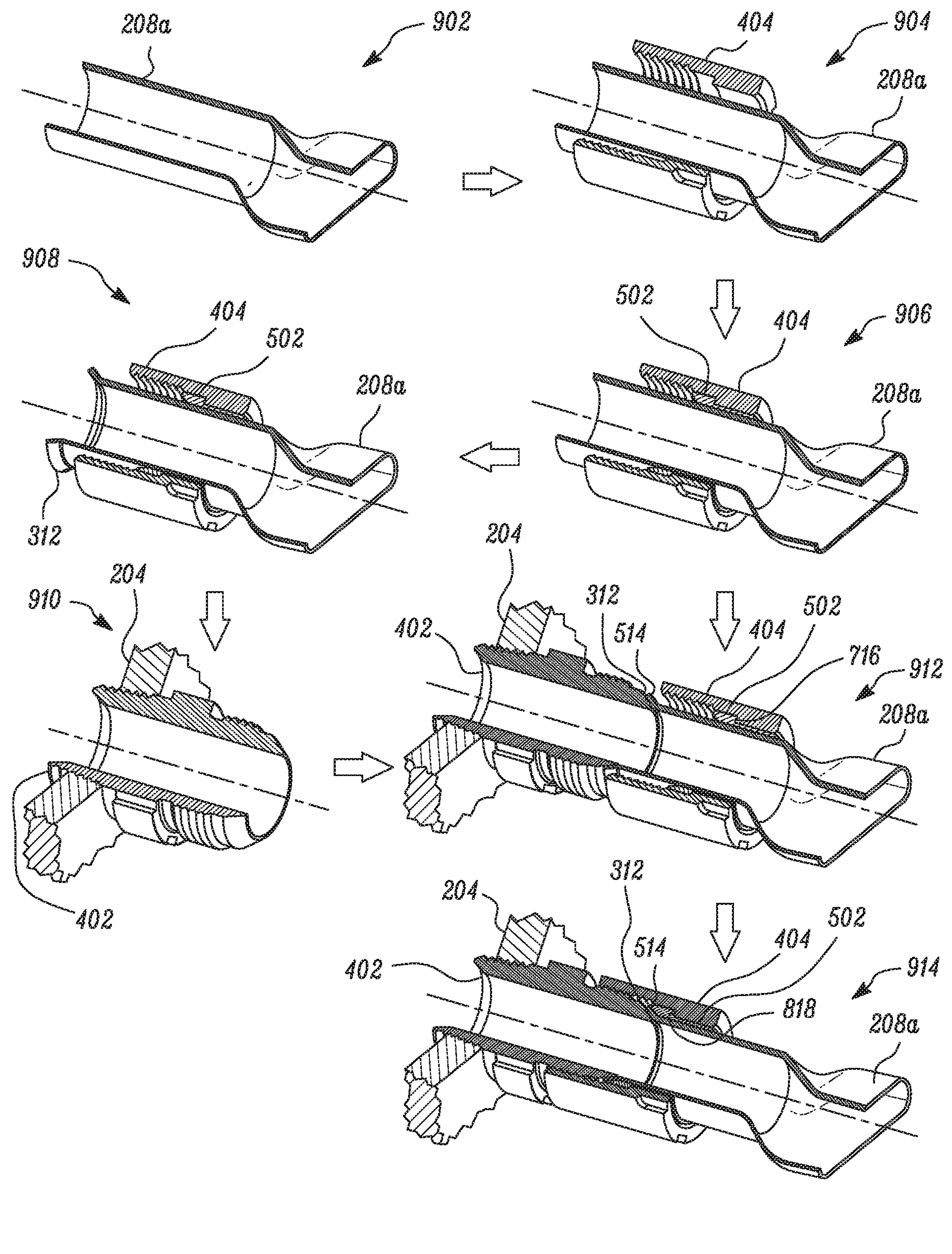


FIG. 8



208a
902
404
904
208a
908
404
502
208a
312
502
404
906
208a
910
204
402
204
402
312
514
404
502
716
912
208a
204
312
402
514
404
502
818
914
208a

FIG. 9

HIGH TEMPERATURE CAPABLE JOINT ASSEMBLY FOR USE IN AIR-TO-AIR AFTERCOOLERS (ATAAC)

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 15/426,595, filed on Feb. 7, 2017.

TECHNICAL FIELD

The present disclosure generally relates to an air-to-air aftercooler (ATAAC) for an engine and, more specifically, to an ATAAC having high temperature capable tube-to-header joint assemblies.

BACKGROUND

Engine systems for many machines, and equipment include an air intake system that delivers intake air to an internal combustion engine for combustion with fuel. The air intake system may include an air compressor that pressurizes the intake air to force more air into the engine for combustion. At higher engine power densities, the temperature of the compressed air at the compressor outlet may approach or even exceed 350° C.

To cool the compressed air before introduction into the engine, the air intake system may also include an air-to-air aftercooler (ATAAC) disposed downstream of the air compressor. The ATAAC may include an inlet end (or a hot end) from where the hot compressed air enters the ATAAC, an outlet end (or a cold end) where the cooled compressed air exits the ATAAC. A typical ATAAC includes a plurality of core tubes that are coupled to headers disposed at both the cold end and the hot end. Usually, the plurality of core tubes are coupled to the headers through a grommet joint. Such grommet joints use rubber composite grommets to couple the plurality of core tubes to the headers. At temperatures greater than 350 degrees, the integrity of the rubber composite grommets (used in the grommet joint) may get compromised, therefore, compromising the integrity of the joint between the plurality of core tubes and the headers, which may be undesirable.

U.S. Pat. No. 7,971,909 discloses a pipe joint and a method of joining pipes using a pipe joint. The pipe joint includes a joint body, a fastening member such as a nut, and a sleeve. The sleeve is integrated with the fastening member or the joint body before the fastening member is attached to the joint body. When the fastening member is attached to the joint body, the sleeve is cut off and separated from the fastening member or joint body. When the nut is fully attached, the sleeve bites into the pipe, and the pipe is joined to the joint body.

SUMMARY

In accordance with an aspect of the present disclosure an air-to-air aftercooler (ATAAC) for an engine system is disclosed. The ATAAC includes a header, disposed at an end of the ATAAC, adapted to receive hot air, the header comprising a first surface, a second surface, and defining a plurality of slots extending from the first surface to the second surface. Further, the ATAAC includes a plurality of core tubes, each of the plurality of core tubes having a flared end portion. The plurality of core tubes are coupled with the header through a plurality of joint assemblies each of the

plurality of joint assemblies includes an adapter. The adapter further includes a first section threadedly engaged with one of the plurality of slots. The adapter further includes a tapered section inserted inside the flared end portion of one of the plurality of core tubes. Furthermore, the adapter includes a second section defined between the tapered section and the first section. Additionally, each of plurality of joint assemblies a sleeve disposed around the one of the plurality of core tubes, the sleeve is engaged with the flared end portion of the one of the plurality of core tubes. Further, each of the joint assembly includes a nut engaged with the sleeve and the second section of the adapter, wherein the engagement of the nut with the sleeve and the second section facilitates retention of the tapered section of the adapter within the flared end portion of the one of the plurality of core tubes.

In accordance with an aspect of the present disclosure an engine system is disclosed. The engine system includes an engine, a compressor coupled upstream of the engine and is configured to provide compressed air to the engine. Further, the engine system includes an air-to-air aftercooler (ATAAC) coupled downstream of the compressor and upstream of the engine. The ATAAC includes a header, disposed at an end of the ATAAC, adapted to receive hot air, the header comprising a first surface, a second surface, and defining a plurality of slots extending from the first surface to the second surface. Further, the ATAAC includes a plurality of core tubes, each of the plurality of core tubes having a flared end portion. The plurality of core tubes are coupled with the header through a plurality of joint assemblies each of the plurality of joint assemblies includes an adapter. The adapter further includes a first section threadedly engaged with one of the plurality of slots. The adapter further includes a tapered section inserted inside the flared end portion of one of the plurality of core tubes. Furthermore, the adapter includes a second section defined between the tapered section and the first section. Additionally, each of plurality ofjoint assemblies a sleeve disposed around the one of the plurality of core tubes, the sleeve is engaged with the flared end portion of the one of the plurality of core tubes. Further, each of the joint assembly includes a nut engaged with the sleeve and the second section of the adapter, wherein the engagement of the nut with the sleeve and the second section facilitates retention of the tapered section of the adapter within the flared end portion of the one of the plurality of core tubes.

In accordance with an aspect of the present disclosure a method of connecting a core tube to a header disposed at an end of an air-to-air aftercooler (ATAAC) is disclosed. The method includes threadedly engaging a first section of an adapter to a slot defined in the header. Further, the method includes receiving a nut around the core tube. Furthermore, the method includes disposing a sleeve around the core tube, wherein the nut engages with the sleeve, wherein the nut and the sleeve are slidable with respect to the sleeve. Thereafter, the method includes flaring a first end of the core tube to form a flared end portion of the core tube. The method further includes inserting a tapered section of the adapter in the flared end portion of the core tube. Additionally, the method includes threadedly engaging the nut with a second section of the adapter to engage the nut with the sleeve, wherein the engagement of the nut with the sleeve facilitates engagement of the sleeve with the flared end portion to retains the adapter engaged with the flared end portion of the core tube.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** illustrates a schematic of an exemplary engine system, in accordance with the present disclosure;

FIG. 2 illustrates a perspective view of an air-to-air aftercooler (ATAAC), in accordance with the present disclosure;

FIG. 3 illustrates a sectional perspective view of a core tube, in accordance with the present disclosure;

FIG. 4 illustrates a perspective view of the core tube coupled to the first header of the ATAAC, in accordance with the present disclosure;

FIG. 5 illustrates a perspective view of the core tube coupled to the first header of the ATAAC, in accordance with the present disclosure;

FIG. 6 illustrates a sectional perspective view of an adapter, in accordance with the present disclosure;

FIG. 7 illustrates a sectional perspective view of a sleeve, in accordance with the present disclosure;

FIG. 8 illustrates a sectional perspective view of a nut, in accordance with the present disclosure; and

FIG. 9 illustrates a flow diagram illustrating a method for coupling the core tube with the first header of the ATAAC, in accordance with the present disclosure.

DETAILED DESCRIPTION

Referring to FIG. **1** an engine system **100** is illustrated. The engine system **100** may be applied in a variety of machines, such as, but not limited to, excavators, loaders, dozers, compactors, paving machines, draglines, off-highway trucks, mining trucks, locomotives, and similar other machines, such as those that are applicable in a construction industry, including autonomous machines and semi-autonomous machines. In some implementations, aspects of the present disclosure may be extended to stationary power generating machines, and to machines that are applied in commercial and domestic environments. The engine system **100** includes an engine **102**, a turbocharger **104**, an exhaust conduit **106**, and an aftercooler **108**. The turbocharger **104** further includes a compressor **110** and a turbine **112**.

The engine **102** may be configured to receive a fuel, such as natural gas (or any of one or more components of natural gas), diesel, or hydrogen (H_2), for combustion. The engine **102** may ignite the fuel to generate energy, which is thereafter used to power various components of the machine in which the engine **102** is used. The ignition of the fuel generates exhaust gases, which are communicated to the turbine **112** of the turbocharger **104** through a conduit **114**. The exhaust gases drive an impeller (not shown) of the turbine **112** of the turbocharger **104**. The impeller of the turbine **112** is coupled to the compressor **110** through a shaft. The movement of the impeller of the turbine **112** causes the compressor **110** to operate. The compressor **110** compresses the air from the ambient and delivers the compressed air to the engine **102** through the aftercooler **108**. The aftercooler **108** may correspond to a heat exchanger that is configured to cool the compressed air before the compressed air is delivered to the engine **102**. Some examples of the aftercooler **108** may include, but are not limited to, air-to-air aftercooler (ATAAC), radiator, and/or the like. For the purpose of the ongoing description, the aftercooler **108** has been considered as the ATAAC **108**. The structure of the ATAAC **108** will be described in conjunction with FIG. **2**.

Referring to FIG. **2** a perspective view of the ATAAC **108** is illustrated. The ATAAC **108** includes a frame **202**, a first header **204**, a second header **206**, and a plurality of core tubes **208**. The frame **202** includes a first member **210**, a second member **212**, a third member **214**, and a pair of fourth members **216**. The first member **210**, the second member **212**, and the third member **214** extend between the first header **204** and the second header **206**. In an embodiment, the first member **210**, the second member **212**, and the third member **214** are equally spaced apart along a length of the first header **204** and the second header **206**, and are substantially parallel to each other. Further, each of the first member **210**, the second member **212**, and the third member **214** is substantially perpendicular to the first header **204** and the second header **206**. The pair of fourth members **216** is coupled to each of the first member **210**, the second member **212**, and the third member **214**. Further, the pair of fourth members **216** is placed substantially parallel to the first header **204** and the second header **206**, and is equally spaced apart from the first header **204** and the second header **206**.

The first header **204** includes a first surface **218** and a second surface **220**. The first header **204** is placed in the ATAAC **108** in such a manner that the second surface **220** is proximal to the second header **206** and the first surface **218** is distal from the second header **206**. Further, first header **204** includes a plurality of slots **222** that extend from the second surface **220** of the first header **204** to the first surface **218** of the first header **204**. In an embodiment, each of the plurality of slots **222** has a circular cross section and has an inner surface**224** that is threaded (represented by **226**). In an embodiment, the threads **224** defined on the inner surface **224** of each of the plurality of slots **222** correspond to pipe threads.

Similar to the first header **204**, the second header **206** also has a first surface **226** and a second surface **228**. The second header **206** is placed in the ATAAC **108** in such a manner that the second surface **228** is proximal to the first header **204** and the first surface **226** is distal from the first header **204**. Further, similar to the first header **204**, the second header **206** includes a plurality of slots (not shown) that extend from the second surface **228** of the second header **206** to the first surface **226** of the second header **206**. In an embodiment, the plurality of slots defined in the second header **206** has an inner surface that is non-threaded. In an embodiment, the first header **204** defines a first end **230** of the ATAAC **108**, and the second header **206** defines a second end **232** of the ATAAC **108**. The first header **204**, disposed at the first end **230** of the ATAAC **108**, is configured to receive hot compressed air from the compressor **110**. The second header **206**, disposed at the second end **232** of the ATAAC **108**, is configured to provide cooled compressed air to the engine **102**. Therefore, the first end **230** of the ATAAC **108** and the second end **232** of the ATAAC **108** may correspond to a hot end **230** and a cold end **232** of the ATAAC **108**, respectively.

The process of cooling the hot compressed air is performed by the plurality of core tubes **208** coupled to the first header **204** of the ATAAC **108** and the second header **206** of the ATAAC **108** through the plurality of first joint assemblies **234** and a plurality of second joint assemblies (not shown).

Referring to FIG. **3**, a sectional perspective view of a core tube **208***a* of the plurality of core tubes **208**, is illustrated. The core tube **208***a* includes a first end **302**, a second end **304**, a first section **306**, a second section **308**, and a center portion **310** defined between the first section **306** and the second section **308**. Further, the first section **306** includes a flared end portion **312** and a tube portion **314**. The flared end portion **312** extends axially from the first end **302** of the core tube **208***a* to the tube portion **314** and may be formed by flaring a portion of the first section **306**. Therefore, an inner diameter of the flared end portion **312** increases along an axial direction from the tube portion **314** to the first end **302**. Therefore, the flared end portion **312** has a maximum inner diameter at the first end **302** and a minimum inner diameter at a junction **316** of the flared end portion **312** and the tube portion **314**. The flared end portion **312** has an inner surface **318** and an outer surface **320**.

The tube portion **314** of the first section **306** extends axially from the junction **316** (i.e., the junction of the flared end portion **312** and the tube portion **314**) to the center portion **310**. In an embodiment, the tube portion **314** may have a circular cross-sectional shape. Further, the center portion **310** of the core tube **208***a* may have an oval cross-sectional shape. In an embodiment, the center portion **310** of the core tube **208***a* may include fins **322** that facilitate heat exchange between the hot compressed air (received from the compressor **110**) flowing through the core tube **208***a*, and the ambient air flowing outside of the core tube **208***a*. It may be contemplated that other core tubes of the plurality of core tubes **208** may have a similar structure to that of the core tube **208***a*.

The second section **308** extends axially from the center portion **310** to the second end **304**. The second end **304** is coupled to the plurality of slots defined in the second header **206**. Further, the first end **302** of the core tube **208***a* is coupled to first header **204** at a slot **222***a* through a joint assembly **234***a* of the plurality of first joint assemblies **234**. The structure of the joint assembly **234***a* has been described in conjunction with FIG. **4** and FIG. **5**.

Referring to FIG. **4** and FIG. **5**, a perspective view and a sectional view of the core tube **208***a* coupled to the first header **204** through the joint assembly **234***a*, are illustrated. The joint assembly **234***a* includes an adapter **402**, a sleeve **502** (refer FIG. **5**), and a nut **404**.

Referring to FIG. **5** and FIG. **6**, the adapter **402** includes a first end **504**, a second end **506**, a first section **508**, a flange section **510**, a second section **512**, and a tapered section **514**. Further, the adapter **402** has an outer periphery **516** and an inner periphery **518**. The inner periphery **518** of the adapter **402** defines a channel **520**.

The first section **508** of the adapter **402** extends axially from the first end **504** to the flange section **510**. Further, the outer periphery **516** of the adapter **402** at the first section **508** is threaded (represented by **522**) and is configured to engage with one of the plurality of slots **222** defined in the first header **204**. FIG. **5** illustrates the engagement of the first section **508** of the adapter **402** with the slot **222***a* defined in the first header **204**. In an embodiment, the threads **522** defined on the outer periphery **516** of the adapter **402** at the first section **508** correspond to pipe threads.

The flange section **510** of the adapter **402** extends axially from the first section **508** of the adapter **402** to the second section **512** of the adapter **402**. In an embodiment, an outer diameter of the adapter **402** at the flange section **510** is greater than an outer diameter at other sections of the adapter **402**. For example, the outer diameter at the flange section **510** of the adapter **402** is greater than the outer diameter of the adapter **402** at the first section **508**. Further, the outer periphery **516** of the adapter **402** at the flange section **510** defines a plurality of grooves **602** that extend axially along a length of the flange section **510**. The plurality of grooves **602** enables the usage of a fastening tool (e.g., a wrench) to fasten the first section **508** of the adapter **402** with the plurality of slots **222**.

The second section **512** of the adapter **402** extends axially from the flange section **510** of the adapter **402** to the tapered section **514** of the adapter **402**. In an embodiment, the outer periphery **516** of the adapter **402** at the second section **512** is threaded (represented by **524**). In an embodiment, the threads **524** formed on the outer periphery of the second section **512** of the adapter **402** is different from the threads **522**. For example, the threads **522** corresponds to the pipe threads and the threads **524** corresponds to non-pipe threads.

The tapered section **514** extends axially from the second section **512** to the second end **506** of the adapter **402**. In an embodiment, an outer diameter of the adapter **402** in the tapered section **514** decreases along the axial direction from the second section **512**, to the second end **506**. Therefore, the outer diameter of the adapter **402** at the junction of the tapered section **514** and the second section **512** is greater than the outer diameter of adapter **402** at the second end **506**. The tapered section **514** of the adapter **402** is inserted inside the flared end portion **312** of the core tube **208***a* such that an outer surface **517** of the tapered section **514** abuts the inner surface **318** of the flared end portion **312** of the core tube **208***a*.

The sleeve **502** of the joint assembly **234***a* is disposed (see FIG. **5**) around the core tube **208***a*. The sleeve **502** will further described on conjunction with FIG. **7**. FIG. **7** illustrates sectional perspective view of the sleeve **502**. The sleeve **502** includes an inner periphery **702**, an outer periphery **704**, a first end **706**, and a second end **708**. The inner periphery **702** of the sleeve **502** defines a bore **710**. The inner diameter of the sleeve **502** (i.e., the diameter of the bore **710**) is substantially equal to an outer diameter of the tube portion **314** of the core tube **208***a*. In an embodiment, the sleeve **502** may be slidable on the tube portion **314** of the core tube **208***a*. The first end **706** of the sleeve **502** is configured to engage with the outer surface **320** of the flared end portion **312** of the core tube **208***a*.

In an embodiment, the sleeve **502** may include a first portion **712** and a second portion **714**. The first portion **712** extends axially from the first end **706** of the sleeve **502** to the second portion **714**. Further, the second portion **714** of the sleeve **502** extends axially from the first portion **712** of the sleeve **502** to the second end **708**. In an embodiment, an outer diameter of the first portion **712** is greater than the outer diameter of the second portion **714**. Accordingly, a step **716** is defined at a junction of the first portion **712** and the second portion **714**.

Referring back to FIG. **5**, the nut **404** of the joint assembly **234***a* is partially disposed around the sleeve **502** and the core tube **208***a*. Referring to FIG. **8**, the nut **404** includes an outer periphery **802**, an inner periphery **804**, a first end **806**, and a second end **808**. Additionally, the nut **404** includes a first structure **810**, a second structure **812**, and a third structure **814** defined on the inner periphery **804**.

The first structure **810** of the nut **404** extends axially from the first end **806** to the third structure **814**. Further, the first structure **810** of the nut **404** is threaded (represented by **816**) and is configured to engage with the second section **512** of the adapter **402**. The threads **816** are defined on the inner periphery **804** of the nut **404**. Further, the type of the threads **816** defined on the inner periphery **804** of the nut **404** is of the same type as that of the threads **524** defined in the second section **512** of the adapter **402**.

The third structure **814** extends axially from the first structure **810** to the second structure **812**. In an embodiment, an inner diameter of the third structure **814** is same as an inner diameter of the first structure **810**. Further, the inner periphery **804** of the nut **404** at the third structure **814** is non-threaded.

The second structure **812** extends axially from the third structure **814** to the second end **808** of the nut **404**. An inner diameter of the of the second structure **812** is less than the inner diameter of the first structure **810** and the third structure **814**. Therefore, a step **818** is defined at a junction of the second structure **812** and the third structure **814**.

To couple the core tube **208***a* with the slot **222***a*, the first section **508** of the adapter **402** is threadedly engaged with the slot **222***a* (through threaded engagement between the threads defined in the slot **222***a* and the threads **522** on the first section **508** of the adapter **402**). Thereafter, the core tube **208***a* is engaged with the adapter **402** in such a manner that the tapered section **514** of the adapter **402** is inserted into the flared end portion **312** of the core tube **208***a*. The inner surface **318** of the flared end portion **312** abuts the outer periphery **516** of the adapter **402** at the tapered section **514**. Further, to engage the core tube **208***a* with the adapter **402**, the nut **404** (disposed on the sleeve **502**) is threadedly engaged with the second section **512** of the adapter **402**. When the nut **404** engages with the second section **512** of the adapter **402**, the step **818** (defined on the inner periphery **804** of the nut **404**) abuts with the step **716** defined on the outer periphery **704** of the sleeve **502**. Such an abutment of the step **818** with the step **716**, and further movement (towards the first end **302** of the core tube **208***a*) of the nut **404** relative to the second section **512** of the adapter **402**, causes a portion of the sleeve **502** to be pushed over and engaged with the flared end portion **312** of the core tube **208***a*. The engagement of the sleeve **502** with the flared end portion **312** facilitates retention and abutment of the tapered section **514** of the adapter **402** with the flared end portion **312** of the core tube **208***a*, and thereby helps in forming a metal to metal seal between the flared end portion **312** and the tapered section **514**.

INDUSTRIAL APPLICABILITY

Referring to FIG. **9** a flow diagram **900** illustrating a method for assembling the ATAAC **108**, is illustrated. At stage **902**, the core tube **208***a* is provided. Initially, none of the ends (i.e., the first end **302** and the second end **304**) is unflared, i.e., the inner diameter of the core tube **208***a* in the first section **306** is constant. At stage **904**, the nut **404** is disposed around the core tube **208***a*. In an embodiment, the nut **404** is slidable along a length of the first section **306**. Thereafter, at stage **906**, the sleeve **502** is disposed around the first section **306** of the core tube **208***a*. The step **716** of the sleeve **502** engages/abuts the step **818** of the nut **404**. Therefore, when the nut **404** is slides along the length of the first section **306** of the core tube **208***a*, the sleeve **502** also slides along with the nut **404**

At stage **908**, the first end **302** of the core tube **208***a* is flared using one or more known technologies to form the flared end portion **312**. At stage **910**, the first section **508** of the adapter **402** is threadedly engaged with the slot **222***a* of the plurality of slots **222** defined in the first header **204**. Further, at stage **912**, the tapered section **514** of the adapter **402** is inserted in the flared end portion **312** of the core tube **208***a*.

At **914**, the nut **404** is threadably engaged with the second section **512** of the adapter **402**. In an embodiment, as the nut **404** is threadably engaged with the second section **512** of the adapter **402**, the nut **404** moves towards the first end **504** of adapter **402**, thereby causing sleeve **502** to slides towards the flared end portion **312** of the core tube **208***a*. Upon further threaded movement of the nut **404**, the step **818** of the nut **404** pushes against the step **716** of the sleeve **502**, causing the portion of the sleeve **502** to be positioned over a portion of the flared end portion **312** of the core tube **208***a* leading to engagement of the sleeve **502** with the flared end portion **312**. The positioning and engagement of a portion of the sleeve **502** over a flared end portion **312** helps in achieving a metal to metal seal between the flared end portion **312** of the core tube **208***a* and the tapered section **514** of the adapter **402**, achieving a leak proof joint. Further, as the pipe threads are utilized to attached the adapter **402** with the first header **204**, a leak proof joint is formed between the adapter **402** and the first header **204**. In this manner, each of the core tube **208***a* is coupled to the first header **204** resulting in ATAAC that can operate and handle compressed air having high temperature specifically compressed air having temperature above 300 degrees.

What is claimed is:

1. An air-to-air aftercooler (ATAAC) for an engine system, the ATAAC comprising:

a header, disposed at an end of the ATAAC, adapted to receive hot air, the header comprising a first surface, a second surface, and defining a plurality of slots extending from the first surface to the second surface;

a plurality of core tubes, each of the plurality of core tubes having a flared end portion; and

a plurality of joint assemblies coupling each of the plurality of core tubes with the header, the each of plurality of joint assemblies comprising:

an adapter comprising:

a first section threadedly engaged with one of the plurality of slots,

a tapered section inserted inside the flared end portion of one of the plurality of core tubes, and

a second section defined between the tapered section and the first section,

a sleeve disposed around the one of the plurality of core tubes, the sleeve is engaged with the flared end portion of the one of the plurality of core tubes,

a nut engaged with the sleeve and the second section of the adapter, wherein the engagement of the nut with the sleeve and the second section facilitates retention of the tapered section of the adapter within the flared end portion of the one of the plurality of core tubes.

2. The ATAAC of claim **1**, wherein the first section of the adapter has a pipe threads and the second section of the adapter has non-pipe threads.

3. The ATAAC of claim **1**, wherein the flared end portion of the one of the plurality of core tubes has an inner surface, wherein the inner surface of the flared end portion abuts an outer surface of the adapter in the tapered section.

4. The ATAAC of claim **1**, wherein the adapter further comprises a flange section defined between the first section and the second section.

5. The ATAAC of claim **1**, wherein the sleeve comprises a first portion engaged with the flared end portion and a second portion, the first portion having an outer diameter larger than an outer diameter of the second portion to define a first step between the first portion and the second portion.

6. The ATAAC of claim **5**, wherein the nut comprises:

a first structure having inner threads engaged with the second section of the adapter; and

a second structure having an inner diameter smaller than an inner diameter of the first structure to define a second step between the first structure and the second structure, wherein the second structure engages the first portion of the sleeve such that the second step abuts the first step.

7. An engine system, comprising:

an engine;

a compressor coupled upstream of the engine and is configured to provide compressed air to the engine;

an air-to-air aftercooler (ATAAC) coupled downstream of the compressor and upstream of the engine, the ATAAC comprising:

a header, disposed at an end of the ATAAC, adapted to receive hot air, the header comprising a first surface, a second surface, and defining a plurality of slots extending from the first surface to the second surface;

a plurality of core tubes, each of the plurality of core tubes having a flared end portion; and

a plurality of joint assemblies coupling each of the plurality of core tubes with the header, the each of plurality of joint assemblies comprising:

an adapter comprising:

a first section threadedly engaged with one of the plurality of slots,

a tapered section inserted inside the flared end portion of one of the plurality of core tubes, and

a second section defined between the tapered section and the first section,

a sleeve disposed around the one of the plurality of core tubes, the sleeve is engaged with the flared end portion of the one of the plurality of core tubes,

a nut engaged with the sleeve and the second section of the adapter, wherein the engagement of the nut with the sleeve and the second section facilitates retention of the tapered section of the adapter within the flared end portion of the one of the plurality of core tubes.

8. The engine system of claim **7**, wherein the first section of the adapter has a pipe threads and the second section of the adapter has non-pipe threads.

9. The engine system of claim **7**, wherein the flared end portion of the one of the plurality of core tubes has an inner surface, wherein the inner surface of the flared end portion abuts an outer surface of the adapter in the tapered section.

10. The engine system of claim **7**, wherein the adapter further comprises a flange section defined between the first section and the second section.

11. The engine system of claim **7**, wherein the sleeve comprises a first portion engaged with the flared end portion and a second portion, the first portion having an outer diameter larger than an outer diameter of the second portion to define a first step between the first portion and the second portion.

12. The engine system of claim **11**, wherein the nut comprises:

a first structure having inner threads engaged with the second section of the adapter; and

a second structure having an inner diameter smaller than an inner diameter of the first structure to define a second step between the first structure and the second structure, wherein the second structure engages the first portion of the sleeve such that the second step abuts the first step.

13. A method of connecting a core tube to a header disposed at an end of an air-to-air aftercooler (ATAAC), the method comprising:

threadedly engaging a first section of an adapter to a slot defined in the header;

receiving a nut around the core tube;

disposing a sleeve around the core tube, wherein the nut engages with the sleeve, wherein the nut and the sleeve are slidable with respect to the sleeve;

flaring a first end of the core tube to form a flared end portion of the core tube;

inserting a tapered section of the adapter in the flared end portion of the core tube; and

threadedly engaging the nut with a second section of the adapter to engage the nut with the sleeve, wherein the engagement of the nut with the sleeve facilitates engagement of the sleeve with the flared end portion to retains the adapter engaged with the flared end portion of the core tube.

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